New Books

Network Synthesis, Vol. 1

By DAVID F. TUTTLE, Jr. Pp. 1175. Chapman & Hall, 37 Essex Street, London, W.C.2 for John Wiley and Sons. Price £9 8s.

This book is the first part of a treatise on network synthesis that promises to be very comprehensive indeed, for its 1,175 pages are devoted to the steady-state synthesis of two-terminal networks alone. The author's intention to devote his second volume to four-terminal networks is probably wise, for such networks are compounded of two-terminal ones, and the mathematical foundations laid in this first volume should serve most of the requirements of the second.

The outstanding features of this book are its thoroughness and lucidity. The author has recognized that mathematical relationships do not in themselves afford adequate explanation, and appears to share this reviewer's opinion: "Mathematics tells one what it's equal to, but not what it is". Mathematical details are accordingly intermingled with a considerable amount of prose, which greatly facilitates understanding of the subject.

The book comprises fifteen chapters. The first two are of an introductory kind, and recapitulate most of the well-known principles of network analysis. The term "immittance" is introduced as a useful generality embracing the alternatives of impedance and admittance, and an adequate explanation is given of the procedure for normalizing values as an aid to calculation.

The complex-frequency variable is introduced in Chapter 3 in a simple way, and the necessary theory is very well developed over 83 pages. The inclusion of this relevant mathematical background is a commendable feature.

The fourth chapter is devoted to realizability requirements, from energy considerations in a passive network. The author refers, in his chapter-heading, to "—— some remarkable conclusions"; but one cannot help feeling that the treatment is unnecessarily long and complex in relation to the conclusions reached: it does not seem very remarkable for example, that the power supplied instantaneously to a network is the sum of the powers instantaneously stored and dissipated; nor even that the driving-point immittance of a realizable passive network must have a positive real-part.

The properties of driving-point immittance functions, commenced in the fifth chapter, are followed by the synthesis of non-dissipative Foster and Cauer type networks and then *RL* and *LC* networks. The general properties are taken up again in Chapter 8, with particular reference to the minimum reactance/susceptance and resistance/conductance conditions, the important reactance and resistance integral theorems, and computational methods based on the relationships between an immittance and its components, such as those due to Brune, Gewertz and Bode. This chapter is particularly clear and has a practical appeal.

RLC networks are covered in great detail in Chapters 9 and 10, with particular emphasis on Brune's approach and its extensions, and methods of realization not involving mutual inductance.

The theme is then interrupted by a short chapter illustrating some practical applications, followed by one concerned with the impurities in practical network elements. These are important for the realism that they impart, though the author is restricted in his illustrations by the exclusion of four-terminal networks from the preceding sections of the book.

The topic of approximation is explained clearly and in detail, in relation to the practical problem: "The approximation problem we have to solve is to determine a function $Z(p)$ or $Y(p)$, that is rational and positive real, and whose behaviour as a function of frequency is acceptably close to the requirements laid down by the 'customer'" (p. 741).

The Potential Analogy in Chapter 14 embraces 219 pages and, in conjunction with the pole-zero theory developed in the earlier chapters, it possibly represents the most integrated treatment in existence. An extensive knowledge of electrostatics is not assumed and, after the basis of the analogy is demonstrated by reference to the Cauchy-Riemann and Laplace equations, the analogy is developed smoothly to an advanced level by expansion of two-dimensional electrostatic theory from the simple case of a line of charge.

The final chapter, devoted to some thorough numerical illustrations, is followed by two appendices on computation. These include extensive tables for evaluation of resistance and reactance integral functions.

The many numerical illustrations in the text give expression to the author's wise contention on p. 342: "Numerical examples are essential in explaining any synthesis process". But the problems terminating each chapter, though well chosen and sometimes accompanied by useful suggestions, are unaccompanied by answers.

Whereas the adequacy of the explanatory prose has been commended, the author's enthusiasm has often led to the use of superfluous words and phrases. For example, on p. 30, "$j\omega$ being replaced by p, *if you will*"; on p. 70, referring to some equations, "—— *for the time being we merely place them in our tool kit with our other shiny new tools*": and on p. 87, "*We have now finished our excursion into the wonderland of function theory*". A more concise style might have saved a substantial number of pages.

The attractiveness of the publishers' production facilitates and encourages reading. The author is to be congratulated on his compilation of a book, suitable both for systematic study and for reference, which represents a marked advance in exposition of this difficult subject. F.E.R.

The Ionosphere: Its Significance for Geophysics and Radio Communications

By KARL RAWER. Translated from the German by Ludwig Katz. Pp. 202. 72 Figs. Crosby Lockwood & Son Ltd., 26 Old Brompton Road, London, S.W.7. Price 42s.

Some research physicists and engineers interested in the propagation of radio waves by way of the ionosphere may already be acquainted with the German edition of "*Die Ionosphäre*" by K. Rawer, published in 1952. The publication of an English translation of the book will be welcomed by these and the large number of others who are now concerned with the ionosphere and the part it plays in long-distance radio communications. Furthermore, many individuals who are engaged in making ionospheric observations of all kinds as part of the programme of the International Geophysical Year will wish to continue their study and analysis of the scientific results obtained during this period, which ends at 31st December next, and they will find the volume under review of great assistance in this connection.

In the first half of the book the author, who was formerly with the French naval ionospheric prediction service, deals with the physics of the ionosphere and its characteristics as determined by radio-wave soundings from a number of observatories in different parts of the world. The information obtained in this way is supplemented by a knowledge of aurorae, geomagnetism and the general influence of the sun's radiation on the upper atmosphere.

A chapter in the second half describes in some detail the regular features of the ionosphere and the manner in which these depend on frequency, time, season and location. The less regular changes associated with a solar eclipse, or with the co-related phenomena of aurorae and disturbances of the earth's magnetic field, are outlined and illustrated. The final chapter deals with the propagation of radio waves around the earth by successive reflections between the earth's surface and the ionosphere, and the associated problem of

forecasting the most suitable frequency to use for long-distance radio communication.

The book is well illustrated with some photographs of ionospheric sounding records and with many diagrams, a large proportion of which are based on experimental observations. The text is of a suitable length for those—whether engineers or scientists—who require a straightforward introduction to the ionosphere; and a bibliography of references to original papers is provided for those who wish to study the subject in more detail. R.L.S.R.

An Introduction to the Theory of Random Signals and Noise

By W. B. Davenport, Jr. and W. L. Root. Pp. 393 & ix. McGraw-Hill Publishing Co. Ltd., 95 Farringdon Street, London, E.C.4. Price 77s. 6d.

On first receiving this book and glancing haphazardly through the pages I was both pleased and impressed by the inclusion of so many topics in which I was interested, and on which I knew I required further enlightenment. However, on settling down to read through the book more thoroughly and as I progressed slowly from chapter to chapter I was disappointed—not that I had been mistaken in the subjects nor were they scantily treated but I felt an opportunity had been missed.

During the past ten to fifteen years a number of excellent original papers have been published on the problem of random noise and the detection of signals masked by such noise. Unfortunately—perhaps a reflection on an engineer's training—most of these works have caused engineers to burn a lot of midnight oil in order to understand the mathematics involved. In fact this situation has resulted in many cases of quotation of results from these papers without a proper understanding of all the assumptions. This perhaps is particularly true of quotations from Rice's epic work on noise and Shannon's "Mathematical Theory of Communication". What I feel has been missing (except for one or two notable exceptions) is an approach which will encourage the engineer to explore this wide field and make use of the powerful tools it provides.

Most of the material covered in the early chapters of this book (i.e., the fundamentals of probability theory) is already widely published and there are many standard textbooks available. In rewriting such material an opportunity arose to present the information in engineers' language rather than a mathematician's. Davenport and Root have travelled some way along this road, but in my opinion not far enough. Woodward's book "Probability and Information Theory with Applications to Radar" is a good example of the approach I have in mind.

Davenport and Root have based their book on a series of lectures given to a 1st Year Graduate Course at M.I.T., and judging by the content the intake to this Course must have been of a fairly high standard. The authors have obviously worked very hard to collect and collate the scattered material into a logical sequence suitable for presentation in such a course, and there are numerous examples of some very careful thought on the part of the authors—in particular the chapter on 'averages'.

As an example of the use of the methods described in earlier chapters, and also to introduce the reader to further ideas, the problem of shot noise in thermionic valves is given a fairly thorough treatment in chapter 7.

Perhaps the three most useful chapters are 11–14 inclusive, in which the authors deal with optimum linear systems utilizing Weiner's theory, non-linear devices, and the statistical detection of signals. The earlier chapters may be said to provide the tools with which to tackle these problems; e.g., the determination of the probability distributions when the variable is transformed and the relations between correlation functions and frequency spectra. Some knowledge of matrices and vector notation is required, and fairly extensive use is made of transform theory of both Fourier and Laplace. Two appendices deal with impulse functions and integral equations of which considerable use is made.

The final chapter on statistical detection of signals is perhaps one of the most important in the book since it suggests a standard by which we may measure the performance of a system. In many papers this subject is rather glossed over and yet the particular decision criterion used can have a substantial effect on the estimated performance.

A short bibliography lists most of the important contributions to the subject and is, unlike so many bibliographies, international in character. It also refers to Chessin's well-known bibliography on noise published by the I.R.E. which in itself is very comprehensive.

This book which is the first of a group of books to be published by the Lincoln Laboratory, M.I.T., should serve as a very useful reference for engineers in this field, but will present a lot of hard work to anyone trying to start from scratch. There are a number of problems at the end of each chapter which provide useful exercises for the industrious.

J.W.R.G.

Chambers's Technical Dictionary (3rd Edition)

Edited by C. F. Tweney and L. E. C. Hughes, A.C.G.I., D.I.C., B.Sc.(Eng.), Ph.D., M.I.E.E., F.R.S.A. Pp. 1028. W. & R. Chambers Ltd., 11 Thistle Street, Edinburgh 2. Price 35s.

The first edition appeared in 1940. This is the third revised edition and includes a supplement. It aims at giving "definitions of terms that are of importance in pure and applied science, in all branches of engineering and construction, and in the larger manufacturing industries and skilled trades".

The field covered is enormous and the book is the collated work of numerous specialist contributors. The definitions are short and clear. No single reviewer can hope to assess their accuracy as a whole; he can merely regard those in his own specialized field with a critical eye.

The definitions in the electronics and radio field are, in the main, adequate, but there are a few exceptions. For example, negative feedback is stated to be "Interconnexion of the input and output terminals of an amplifier in such a manner that the output opposes the input, resulting in a reduction in amplification, but also in a *corresponding increase in output power obtainable with a given degree of harmonic distortion*". This should read "corresponding decrease of harmonic distortion for a given output power". Feedback does many useful things, but it does not work miracles.

The multivibrator is said to be "characterised by an irregular wave-form of oscillation". One knows that what is meant is a waveform in which the current or voltage does not vary smoothly with time, but those who do not know may well think that it varies erratically and unpredictably, so that successive cycles are unlike.

The definition of a rejector circuit is marred by the concluding words "when placed in series with the antenna circuit of a receiver", for the usage of rejectors is by no means confined to the aerial circuit. In fact, that is where they are now least used. The use of "antenna" instead of "aerial" is irritating and the two words themselves are not properly defined. "Antenna" is stated to be "An elevated and/or extended system of conductors used for the transmission and/or reception of electromagnetic waves."

When we turn to "aerial", however, we find: "Any exposed wire capable of radiating or receiving the energy to or from an electromagnetic wave. The term is preferably restricted to such, and should not be applied to aerial systems which are designed to have special characteristics, to which the term antenna is applicable".

The author may think this is a desirable usage of words but it is not in accord with present or past practice. The two words are synonymous, antenna merely being the American for aerial.

One cannot expect that a work of this magnitude can be free from all error and the pedantic can always find fault with definitions. The foregoing criticism of a few matters must not be taken to imply too much, therefore. There is no doubt at all that the book is an extremely useful one and the reviewer, for one, will certainly keep it handy. W.T.C.

Conductance Curve Manual

By Keats A. Pullen, Jr., Eng.D. Pp. 114. John F. Rider, Publisher Inc., 116 West 14th Street, New York 11, N.Y., U.S.A. Price $4·25.

The major part of this book is taken up by characteristic curves for 71 American receiving-type valves. In the case of triodes, the anode-voltage–anode-current curves are given; and for pentodes and tetrodes, screen-voltage–anode-current curves. Anode dissipation contours are drawn on these, also two other sets of contours, one showing anode conductance and the other mutual conductance. These latter are claimed by the author to "help in the design of circuits which, when actually built, conform closely to the predictions of the calculated design". In fact, the additional information is implicit in the current–voltage curves, and the author states that in the case of triodes his additional curves have